

CLAIMS

What is claimed is:

- 1 1. A system for obtaining at least one calibration  
2 profile for an image scanning apparatus, the system  
3 comprising:  
4 a light source;  
5 a calibration image having a surface illuminated by the  
6 light source;  
7 a detector to measure an intensity of light obtained from  
8 a plurality of points on the calibration image;  
9 a first memory to store a first plurality of light  
10 intensity values measured by the detector at each of the  
11 points; and  
12 a smoothing module to smooth the plurality of light  
13 intensity values in the first memory so as to form a  
14 calibration profile.
- 1 2. A system as recited in claim 1, further comprising a  
2 value corrector to correct a second plurality of light  
3 intensity values measured by the detector for the light  
4 obtained from an arbitrary image at each of the points  
5 using the calibration data.

- 1 3. A system as recited in claim 1, wherein the  
2 calibration image has uniform reflectivity across the  
3 surface
- 1 4. A system as recited in claim 1, wherein the smoothing  
2 module is useful to employ filtering.
- 1 5. A system as recited in claim 1, wherein the smoothing  
2 module is useful to employ extrapolation and decimation  
3 upon data of a subset of the plurality of points.
- 1 5. A system as recited in claim 4, wherein the filtering  
2 includes multirate filtering.
- 1 6. A system as recited in claim 1, wherein the detector  
2 is also useful to measure an intensity of light obtained  
3 from a dark image at the plurality of points, and the  
4 first memory is to also store a plurality of black  
5 intensity values measured by the detector at each of the  
6 points to form a black calibration profile.
- 1 7. A system as recited in claim 6, wherein the smoothing  
2 module is also useful to smooth the plurality of black  
3 intensity values in the first memory.
- 1 8. A system as recited in claim 7, wherein the smoothing  
2 module is useful to employ extrapolation, filtering and  
3 decimation upon data of a subset of the plurality of  
4 points.
- 1 9. A system for scanning images, the system comprising:

2 means for providing light;

3 means for measuring at a number of points on a  
4 transparent object, the intensity of light emitted from  
5 the means for providing light transmitted through the  
6 transparent object to form a first raw profile; and

7 means for smoothing the first raw profile to form a  
8 calibration profile.

1 10. A system for scanning images as recited in claim 9,  
2 further comprising:

3 means for measuring the intensity of light from the light  
4 transmitted through an opaque object at the number of  
5 points to form a second raw profile; and

6 means for smoothing the second raw profile to form a  
7 black calibration profile.

1 11. A system for scanning images as recited in claim 9,  
2 further comprising:

3 means for measuring the intensity of light from the light  
4 transmitted through a semi-transparent object at the  
5 number of points to form a semi-transparent object  
6 profile; and

7 means for correcting the semi-transparent object profile  
8 using the calibration profile.

1 12. A system for scanning images as recited in claim 11,  
2 further comprising means for correcting the semi-  
3 transparent object profile using the black calibration  
4 profile.

1 13. A method for improving an initial calibration  
2 profile having an initial profile extent to form an  
3 improved calibration profile, the initial calibration  
4 profile formed for a scanner employing a linear array CCD  
5 and having a direction of motion, the method comprising:

6 forming for the initial calibration profile an  
7 extended profile extent in the direction of  
8 motion using quadratic extrapolation;

9 applying multirate filtering to the extended  
10 profile to form a filtered profile; and

11 truncating the filtered profile to bring it to  
12 the initial profile extent to form the improved  
13 calibration profile.

1 14. A method as recited in claim 13, further comprising  
2 comparing the improved calibration profile to the initial  
3 calibration profile to determine at least one occurrence  
4 of a problem condition; and flagging said at least one  
5 occurrence.

1 15. A method as recited in claim 14, further comprising  
2 evaluating the flags of said at least one occurrence to  
3 determine the usability of the improved calibration  
4 profile.

- 1 16. A method as recited in claim 13, wherein the  
2 calibration profile is a white calibration profile.
- 1 17. A method as in claim 13, wherein the step of forming  
2 extends a subset of the initial calibration profile by a  
3 factor of four.
- 1 18. A system as in claim 1, wherein the calibration  
2 image is obtained from chromalin paper.
- 1 19. A system as recited in claim 1, wherein the detector  
2 is a CCD detector.
- 1 20. A system as recited in claim 1, wherein the  
2 plurality of points are positions of pixels of the  
3 calibration image, the calibration image having x rows of  
4 pixels and y columns of pixels.
- 1 21. A method for developing a valid calibration profile  
2 for a scanning system, the method comprising:
- 3 scanning an image to obtain the plurality of  
4 calibration signals to an initial extent of the  
5 image;
- 6 extrapolating the calibration signals to form  
7 extended range signals;
- 8 applying multirate filtering to the extended  
9 range signals to form a plurality of filtered  
10 signals; and

11 truncating the plurality of filtered signals to  
12 the initial extent to form said at least one  
13 valid profile.

1 22. A method as recited in claim 21, wherein the at  
2 least one valid profile includes both a white and a black  
3 calibration profile.

1 23. A method as recited in claim 21, further comprising:  
  
2 scanning an arbitrary image to obtain an  
3 plurality of arbitrary signals; and employing  
4 said at least one calibration profile to  
5 correct the plurality of arbitrary signals.

1 24 An article of manufacture comprising:

2 a computer usable medium having computer readable program  
3 code means embodied therein for causing the development  
4 of a valid calibration profile for a scanning system, the  
5 computer readable program code means in said article of  
6 manufacture comprising computer readable program code  
7 means for causing a computer to effect:

8 scanning an image to obtain the plurality of  
9 calibration signals to an initial extent of the  
10 image;

11 extrapolating the calibration signals to form  
12 extended range signals;

13 applying multirate filtering to the extended  
14 range signals to form a plurality of filtered  
15 signals; and

16 truncating the plurality of filtered signals to  
17 the initial extent to form said at least one  
18 valid profile.

1 25. An article of manufacture as recited in claim 24,  
2 wherein the at least one valid profile includes both a  
3 white and a black calibration profile.

1 26. An article of manufacture as recited in claim 24,  
2 further comprising computer readable program code means  
3 for causing the computer to effect scanning an arbitrary  
4 image to obtain an plurality of arbitrary signals; and  
5 employing said at least one calibration profile to  
6 correct the plurality of arbitrary signals

1 27. A program storage device readable by machine,  
2 tangibly embodying a program of instructions executable  
3 by the machine to perform method steps for developing a  
4 valid calibration profile for a scanning system, said  
5 method steps comprising:

6 scanning an image to obtain the plurality of  
7 calibration signals to an initial extent of the  
8 image;

9 extrapolating the calibration signals to form  
10 extended range signals;

11 applying multirate filtering to the extended  
12 range signals to form a plurality of filtered  
13 signals; and

14 truncating the plurality of filtered signals to  
15 the initial extent to form said at least one  
16 valid profile.

1 28. A program storage device readable by machine, as  
2 recited in claim 27, wherein the at least one valid  
3 profile includes both a white and a black calibration  
4 profile.

1 29. A program storage device readable by machine,  
2 tangibly embodying a program of instructions executable  
3 by the machine to perform method steps for developing a  
4 valid calibration profile for a scanning system, as  
5 recited in claim 27, said method further comprising  
6 scanning an arbitrary image to obtain an plurality of  
7 arbitrary signals; and employing said at least one  
8 calibration profile to correct the plurality of arbitrary  
9 signals.

1 30. A system as recited in claim 8, wherein the  
2 filtering includes multirate filtering.

1 31. A system as recited in claim 30, wherein the  
2 multirate filtering is repeated a number of times.

5.6 C1 > 1 32. A method for scanning images, the method comprising:  
2 providing a source of light;



3 measuring at a number of points on a  
4 transparent object, the intensity of light  
5 emitted from the source of light transmitted  
6 through the transparent object and forming a  
7 first raw profile; and

8 smoothing the first raw profile to form a  
9 calibration profile.

1 33. A method as recited in claim 32, further comprising:

2 measuring the intensity of light from the  
3 source of light transmitted through an opaque  
4 object at the number of points to form a second  
5 raw profile; and

6 smoothing the second raw profile to form a  
7 black calibration profile.

1 34. A method as recited in claim 32, further comprising:

2 measuring the intensity of light from the  
3 source of light transmitted through a semi-  
4 transparent object at the number of points to  
5 form a semi-transparent object profile; and

6 correcting the semi-transparent object profile  
7 using the calibration profile.

1 35. A method as recited in claim 34, wherein the  
2 calibration profile is a white calibration profile, and  
3 further comprising means for correcting the semi-

4 transparent object profile using the black calibration  
5 profile.

1 36. A computer program product comprising a computer  
2 usable medium having computer readable program code means  
3 embodied therein for causing images to be scanned, the  
4 computer readable program code means in said computer  
5 program product comprising computer readable program code  
6 means for causing a computer to effect, the method  
7 comprising:

8 providing a source of light;

9 measuring at a number of points on a  
10 transparent object, the intensity of light  
11 emitted from the source of light transmitted  
12 through the transparent object and forming a  
13 first raw profile; and

14 smoothing the first raw profile to form a  
15 calibration profile.

1 37. A computer program product comprising a computer  
2 usable medium having computer readable program code means  
3 embodied therein for causing images to be scanned, as  
4 recited in claim 36, wherein the calibration profile is a  
5 white calibration program, and the computer readable  
6 program code means in said computer program product  
7 comprising computer readable program code means for  
8 causing a computer to further effect the method  
9 comprising:

10 measuring the intensity of light from the  
11 source of light transmitted through an opaque  
12 object at the number of points to form a second  
13 raw profile; and

14 smoothing the second raw profile to form a  
15 black calibration profile.

1 38. A computer program product comprising a computer  
2 usable medium having computer readable program code means  
3 embodied therein for causing images to be scanned, as  
4 recited in claim 36, the computer readable program code  
5 means in said computer program product comprising  
6 computer readable program code means for causing a  
7 computer to effect the method further comprising:

8 measuring the intensity of light from the  
9 source of light transmitted through a semi-  
10 transparent object at the number of points to  
11 form a semi-transparent object profile; and

12 correcting the semi-transparent object profile  
13 using the calibration profile.

1 39. A computer program product comprising a computer  
2 usable medium having computer readable program code means  
3 embodied therein for causing images to be scanned, as  
4 recited in claim 38, the computer readable program code  
5 means in said computer program product comprising  
6 computer readable program code means for causing a  
7 computer to further effect the method comprising means

8 for correcting the semi-transparent object profile using  
9 the black calibration profile.

1 40. A system as recited in claim 33, wherein the  
2 calibration profile is a white calibration profile.

1 41. A method for improving an initial calibration  
2 profile having an initial profile extent to form an  
3 improved calibration profile, the initial calibration  
4 profile formed for a scanner employing a linear array CCD  
5 and having a direction of motion, the method comprising:

6 applying multirate filtering to the initial  
7 calibration profile so as to form a filtered  
8 profile.

1 42. A system for scanning images as recited in claim 9,  
2 wherein the transparent object is air.

1 43. A system as recited in claim 32, wherein the  
2 transparent object is comprised of glass.

1 44. A computer program product as recited in claim 36,  
2 wherein the transparent object is air.

1 45. A computer product as recited in claim 38, wherein  
2 the transparent object is comprised of a glass base.

1 46. A computer program product as recited in claim 36,  
2 wherein the smoothing is comprised of filtering,  
3 extrapolation and decimation.

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- 1 47. A computer program product as recited in claim 46,
- 2 wherein the filtering includes multirate filtering.

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